DELTA CONSULTING GROUP

EXPERT REPORT OF TONG ZHAO, PHD, PE, PSP, CCP, CFCC

United Stated District Court, Western District of Texas

No. 1:23-CV-853-DAE

United States of America

(Plaintiff)

— vs —

Greg Abbott, and the State of Texas

(Defendant)

JUNE 14, 2024

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1 Introduction

1.1 Engagement

1. This Expert Report is provided at the request of the Office of Attorney General of the State of Texas, resulting from a dispute of United States of America, versus Mr. Gregory Abbott, in his capacity as governor of the State of Texas, and the State of Texas in the United States District Court for the Western District of Texas, Austin Division (Case No. 1:23-cv-00853-DAE) on the commercial navigability of the Rio Grande. Specifically, I was instructed to prepare an independent expert report investigating the economic feasibility to improve the river for commercial navigation. [1]

1.2 Author

2. The analysis and opinions in this Expert Report are the work of Dr. Tong Zhao, Senior Director of Delta Consulting Group, Inc. ("Delta"), assisted by members of Delta's staff under my direct supervision. My Curriculum Vitae is set out as Appendix A to this report. Briefly, my background as an expert in construction and consulting spans more than 20 years and a broad range of infrastructure projects. My expertise includes damage and cost analysis, disruption or loss of productivity ("LOP") analysis, schedule and delay analysis, forensic engineering, project management, and litigation support and expert witness testimony.

3. I have provided testimony and reports on construction costing, delay and LOP in various dispute resolution venues. Additionally, I have been recognized by *Who's Who Legal* in *Construction Expert Witnesses* and *Consulting Experts - Construction – Quantum, Delay and Technical*.

4. My undergraduate and graduate studies were related to the engineering, construction and management of hydraulic structures. I obtained my degree of Doctor of Philosophy from University of Maryland, College Park. My doctoral research was related to evaluating alternatives of infrastructure developments and expansions using advanced methods. Among other professional experiences, I have performed cost estimating and quantum analyses on various construction projects.

[1] I understand the parties are in dispute over the meaning of commercial navigation, which will be decided by the Court. I understand the defendant is taking the position that navigable water for use in its ordinary condition or by reasonable improvement (See Exhibit 23, 33 CFR Part 329) is to serves as a highway of interstate or foreign commerce (*United States v. Appalachian Power Co*., 311 U.S. 377, 407, 411, 413-17 (1940); 33 C.F.R. § 329.4). The expert analysis and opinions in this expert report is based on this premise.

5. I have worked or are working on a number of major civil engineering projects related to hydraulic structures and river improvements, including the Three Gorges Dam Project, the Xiaolangdi Multipurpose Dam Project, the Wanjiazhai Yellow River Diversion Project, the Changuinola Hydroelectric Dam Project, the Chucas Hydroelectric Dam Project, the Panama Canal Third Set of Locks Project, and the Isabella Lake Safety Modification Project.

6. I have authored many papers and book chapters on construction claims and dispute resolution, including those peer-reviewed ones in the *Journal of Construction Engineering and Management*, *Journal of infrastructure systems,* and *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*.

7. All opinions herein are my expert opinions based on my professional judgement and the data I referred to in this report.

8. As reflected in the declaration at the end of this report, I appreciate that my duty in giving evidence in this litigation is to assist the Court in deciding the issues in respect of which my expert opinion is being offered. I confirm that this report reflects my own, impartial, objective, unbiased opinion, which has not been influenced by the pressures of the dispute resolution process or by any party to this litigation.

1.3 Disclosure of Conflicts

9. I confirm that I am aware of no issues that would affect my impartiality and present a conflict of interest in providing an opinion in relation to this matter.

1.4 Scope of this Report

10. This Expert Report will provide expert analysis and opinions related to the economic feasibility to improve the Rio Grande for commercial navigation.

11. I provide no legal opinions in this Expert Report, and no opinion herein should be construed as such. Where my expert analysis or opinions rely on specific documentation or reference materials, I will provide a citation to this. Where my expert analysis or opinion rely on my personal experience, assumptions and/or instructions, I will seek to identify these clearly. I reserve the right to update my findings should additional information be provided to me.

12. This report does not deal with issues of liability, legal entitlement, and technical merit. I understand these issues either have been or will be addressed by the defendant in the proceedings or opined on by other experts on behalf of the defendant.

2 Summary of Expert Opinions

13. A project to improve navigability of a river is a federal water resource development project managed by United States Army Corps of Engineers (USACE). Before a water resource development project can be selected and proceeded, USACE needs to seek authorizations and appropriations from Congress to perform a feasibility study. Only the projects that are technically feasible, economically justified, and environmentally acceptable can be recommended to Congress for authorization and appropriation for construction.

14. The feasibility study required by USACE to justify a water resource development project requires thorough investigation, appropriate design and engineering defining the features and scope of the works, and adequate cost estimating, economic evaluation, and environmental assessment, along with sufficient supporting documentation. I am not aware that there is a feasibility study (including a cost-benefit analysis) done by USACE or other parties for improving the Rio Grande to achieve commercial navigation. To my best knowledge, there is no detailed information compatible with the USACE requirements from public sources or produced by USA on this case which allow performing a detailed feasibility study, neither the authorization nor appropriations from Congress.

15. Due to limited data availability, I performed a high-level cost-benefit analysis in which two potentially technically feasible improvement alternatives are considered. Alternative 1 includes a series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling. Alternative 2 includes a series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.

16. Both Alternatives 1 and 2 are not economically feasible due to high construction, operation and maintenance costs and limited benefits.

17. A sensitivity study shows that the finding of the economically infeasibility of Alternatives 1 and 2 is highly insensitive to the granularity of data that can be available, and thus is robust. This indicates that any practical variants for Alternatives 1 and 2 would not be economically feasible.

3 Background on Cost-Benefit Analysis for Federal Water Resource Development Projects

3.1 Process for Federal Water Resource Development Projects

18. Federal water resource development projects are generally the projects managed by the United States Army Corps of Engineers (USACE) principally to improve navigable channels, reduce flood risks along rivers and coasts, and/or restore aquatic ecosystems. Undertaking federal water resource development projects is one of the civil responsibilities of the USACE.[2]

19. The standard process for a USACE project consists of four phases: study, design, construction, and operations, as shown in Figure 1.[3] The process requires two separate congressional authorizations, one for studying the feasibility, and the other for implementing the construction. An exception may be given to smaller projects with a federal cost less than $10 million to bypass the required two-authorization process, but these small projects still require review and approval by USACE under its continuing authorities programs.[4] Because of its magnitude, the potential improvements of the Rio Grande to achieve commercial navigation would be a federal water resource development project requiring two authorizations from US Congress.

20. However, the process shown in Figure 1 is not automatic. Appropriations are required in order to initiate and complete studies, preconstruction engineering and design (PED), and construction. In other words, in order for a water resource development project to be proceeded, both authorization and appropriations are needed for USACE.[5]

[2] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF pages 2 and 9.
[3] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 7.
[4] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 2.
[5] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 6.

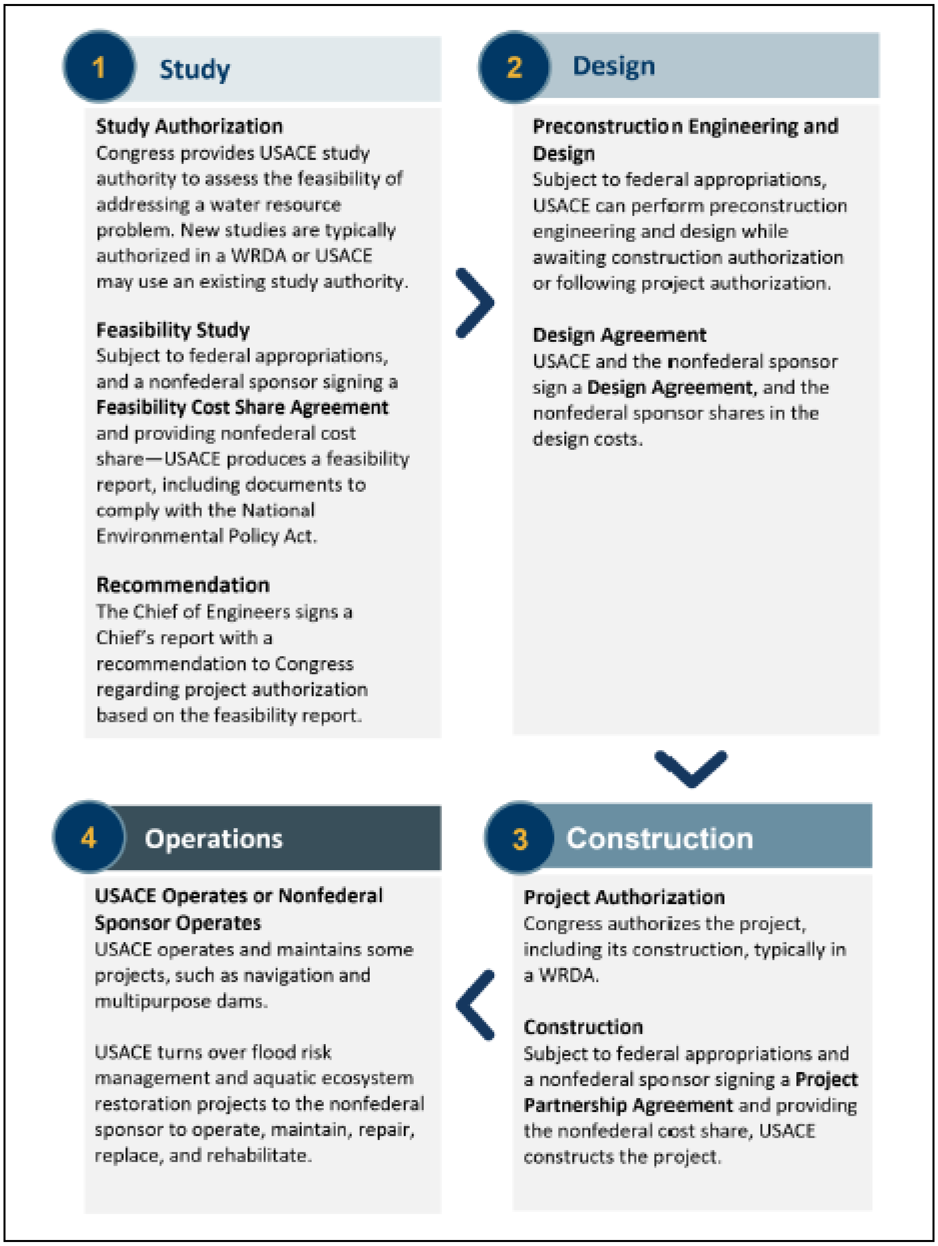

Figure 1 – Typical Process for USACE Federal Water resource development projects

3.2 Federal Requirements on the Feasibility of a Water Resource Development Project

21. Once the (feasibility) study is authorized and appropriations are approved by Congress, the (feasibility) study phase can start which includes the development of alternative plans, initial design, cost estimating, economic analysis, environmental analyses, real estate evaluation, and others. The definition of alternative plans and initial design

provide scoping information required for various analyses, including cost estimating, economic analysis, environmental analyses and others.[6]

22. For projects that can be recommended to Congress, they need to be technically feasible, economically justified, and environmentally acceptable.[7] For the development of a waterway for commercial navigation, the feasibility study needs to cover relevant information, including:[8]

a) the amount and type of traffic that could be developed,

b) commodities that would be moved on the waterway,

c) effect on the environment,

d) economic development of the region,

e) the initial design, and

f) the estimated cost of construction, maintenance, and operation.

23. To my best knowledge, there is not a feasibility study for commercial navigation on the Rio Grande prepared by USACE or any other entities to date. In the expert reports prepared by the USA experts, none of the above information was included or addressed regarding the feasibility of a potential improvement on the Rio Grande for commercial navigation in the context of interstate or foreign commerce, though the possibilities of non-commercial navigation were suggested by the USA experts.[9]

3.3 Federal Requirements on the Cost-Benefit Analysis for a Water Resource Development Project

24. For a water resource development project, especially an inland navigation project, a cost-benefit analysis is required to compare the economic benefits of project alternatives to the investment costs of those alternatives.[10]

[6] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 12.

[7] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 9.

[8] See Exhibit 30, "Inland Navigation: Locks, Dams, and Channels," PDF page 7.

[9] Expert Report of Adrian Cortez, supplemented on May 21, 2024; Expert Report of Timothy MacAllister.

[10] See Exhibit 27, "Process for U.S. Army Corps of Engineers (USACE) Projects," PDF page 13; Exhibit 28, "USACE Inland Navigation Economics: Cost-Benefit Analysis 101;" and, Exhibit 29, "US Army Cost Benefit Analysis Guide," 3rd Edition.

3.3.1 Key Elements for a Cost-Benefit Analysis

25. Various federal agencies, including USACE, accept the general principle of benefits exceeding costs in recommending projects.[11] In order to perform a cost-benefit analysis for a water resource development project, both relevant costs and benefits need to be quantified.

26. The costs can include material, labor, and other construction costs, operation and maintenance costs, environmental mitigation costs, real estate costs and other improvements costs.[12]

27. There are four types of accounts that can be used to evaluate the benefits in a cost-benefit analysis:[13]

a) The National Economic Development (NED) account, which shows changes in economic value of the national output of goods and services. The NED benefits for a water resource development project can include reduced or avoided flood damages/costs, and reduced costs for commodity transport.

b) The Environmental Quality (EQ) account, which shows effects on significant natural and cultural resources.

c) The Regional Economic Development (RED) account, which shows the regional or localized impacts resulting from each alternative.

d) The Other Social Effects (OSE) Account shows other effects that are not reflected in the above three accounts.

28. RED, environmental and social benefits are only considered for the alternatives which are recommended to Congress, which are with a Benefit-Cost Ratio (BCR) greater than 1. For alternatives with a BCR no more than 1, RED, environmental and social benefits are not part of the cost-benefit analysis.[14]

3.3.2 Expected Level of Details for Cost Estimating

29. Per USACE Engineer Regulation 110-2-1302, "Civil Works Cost Engineering," cost estimate required for a project feasibility study is at least Class 3, as shown in Figure 2. Class 3

[11] See Exhibit 26, "Economics Primer," page 1.
[12] See Exhibit 26, "Economics Primer," page 5.
[13] See Exhibit 26, "Economics Primer," page 3.
[14] See Exhibit 26, "Economics Primer," page 6; Exhibit 28, "USACE Inland Navigation Economics: Cost-Benefit Analysis 101," page 7.

estimates need to be supported for sufficient scoping documents, including design, acquisition, and construction methods, as shown in Figure 3.[15]

Project Phase	Scope and Technical Definition		Risk Level	Minimum Estimate Class
Pre-Budget Development (not recommended for reports)	Extremely Limited		Extremely High	**5***
	Pre-Authorization			
Initial Alternatives	Very Limited		Very High	4*
Feasibility Alternatives	Very Limited		High	4*
Feasibility – Federal Recommended Plan	Limited-Fair		Moderate	3
National Economic Decision (NED)	Limited-Fair		Moderate	3
Locally Preferred Plan (LPP)	Limited-Fair		Moderate	3
Funding Request Decision Documents	Limited-Fair		Moderate	3
	Authorization			
Continuing Authorities Program	Limited		Moderate to High	3-4
Civil Emergency Management Program	Limited		Moderate to High	3-4
Alternative Studies	Limited		Moderate to High	3-4
General Re-Evaluation Report	Limited-Fair		Moderate	3
Limited Re-Evaluation Report	Limited-Fair		Moderate	3
Design Documentation Report	Limited-Fair		Moderate	3
Engineering Decision Report	Limited-Fair		Moderate	3
Post Authorization Change Reports	Fair		Moderate	2-3
Other Funding Decision Documents	Limited-Fair		Moderate	3
	Preconstruction, Engineering & Design (working estimates)			
PED 30%	Fair		Moderate	3
PED 60%	Fair-Good		Moderate to Low	2
PED 90%	Very Good		Low	1
IGE <100% Design	Fair-Good		Moderate to Low	2
IGE 100% Design	Very Good		Low	1
	Construction / Post Award			
Budgets (modifications / claims)	Fair-Good		Moderate to Low	2
IGEs (modifications / claims)	Very Good		Low	1

* Do not use in formal/Chief of Engineer's Reports

Figure 2 – USACE Civil Works Estimates – Class Level Designation

[15] See Exhibit 24, USACE ER 110-2-1302, "Civil Works Cost Engineering."

(3) Class 3 – Technical information (including designs) are approaching a 10-60% quality of project definition. There is greater confidence in project planning and scope, construction elements and quantity development. The estimates rely less on generic cost book items, greater reliance on quotes, recent historical and site-specific crew based details. Class 3 estimates are a reflection of improved technical documents. The estimates must be supported by a technical information (scope, design, acquisition and construction methods, etc.) discussion within the estimate and the uncertainties associated with each major cost item in the estimate. Special attention must be given to large construction elements and items that are sensitive to technical information change. Typical Contingency Range could be 20% to 50%.

Figure 3 – Excerpts from Civil Works Cost Engineering – Class 3 Estimate

3.3.3 Key Supporting Information for a USACE Cost-Benefit Analysis

30. The cost-benefit analysis is required by the USACE to be supported by technical details included in the feasibility report appendices, which include:[16]

a) Engineering appendix (200 pages), which may include engineering detail on project features, hydrology, hydraulics, geotechnical, mechanical, and electrical engineering products as well as the operations and maintenance of the project.

b) Cost engineering appendix (40 pages), which includes planning level estimates, required analysis and outputs.

c) Environmental appendix (375-450 pages), which can include surveys, contracted work, and other pertinent data related to work quality and environment.

d) Real estate appendix (30 pages), which includes an analytic summary of crediting considerations, flooding analysis, estate analysis, and supporting tables and graphics.

e) Economic and social consideration appendix, which includes detailed economic data and analysis to support plan formulation, forecasts, and detailed explanation of benefits.

f) Other appendixes that include information for recreation and public involvement.

[16] See Exhibit 25, "Feasibility Report Format and Content Guide."

4 Analysis Methodology

31. Since there is not a feasibility study prepared for the potential improvement of the Rio Grande for commercial navigation, nor adequate data defining the features, design, engineering and methods, I can only rely on very preliminary technical information through my research and that included in other experts' reports, which only allow me to perform a Class 5 estimate, as described in Figure 4.

> (1) Class 5 – Preliminary technical information (0-5%). These estimates are commonly referred to as "Rough Order of Magnitude (ROM)." There is considerable risk and uncertainty inherent in a Class 5 estimate, resulting in high contingencies. These estimates are NOT recommended in reports because the extremely limited information and high risk poses credibility issues in quality and accuracy. Project designs, methods, and quantity development are unclear or uncertain. There is great reliance on broad-based assumptions, costs from comparable projects and data, cost book, cost engineering judgment and parametric cost data. Development may consist of lump sum cost. Detailed cost items are not required or captured. Each PDT must identify areas of risk and uncertainty in the project and describe them clearly in an effort to improve quality and confidence to a Class 4 estimate level for external reporting purposes. Establishing a credible contingency with qualifications is necessary. Typical Contingency Range could be 40% to 200%.

Figure 4 – Excerpts from Civil Works Cost Engineering – Class 5 Estimate

32. My analysis steps include:

a) Identify various alternatives.

b) Perform the following tasks for each alternative:

i) Estimates are performed on costs and benefits.

ii) Both costs and benefits are converted to present values by using the net present value analysis.

iii) After that the net benefit is calculated as the difference between the present values of benefits and costs.

iv) The Benefit to Cost Ratio (BCR) is calculated as the present value of benefits divided by the present value of costs.

c) For an alternative, if the net benefit is less than zero, it is not recommended; or if the BCR is less than 1, it is not recommended.

d) Among the alternatives with net benefit greater than zero or BCR greater than 1, further analysis is needed to assess other relevant factors. If no alternatives with net benefit greater than zero or BCR greater than 1, then the base alternative with no improvement is recommended.

33. The assumptions in estimating costs and benefits are elaborated in the subsequent sections.

5 Potential Improvements for Commercial Navigation on the Rio Grande

34. The type of waterway that could be developed is governed by local conditions. Due to the steep slope of the Rio Grande, and the constraint on the amount of available water that could be used for commercial navigation purposes, I understand that the open river approach (without a system of locks and dams) alluded by Mr. Timothy MacAllister and Mr. Adrain Cortez is not technically feasible. [17]

35. The other option is the approach of canalized streams with a system of locks and dams, which requires less flow compared to the open river approach.[18] Two alternatives relying on the approach of canalized streams with a system of locks and dams are considered, as shown in Figure 5:[19]

  a) **Alternative 1**: A series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling.

  b) **Alternative 2**: A series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.

36. Note that in order to conserve water for the intended agricultural and municipal uses, any improvement alternatives without water recycling measures are not practically feasible.[20]

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[17] Expert Report of F. D. Shields; Expert Report of Ancil Taylor.

[18] Expert Report of F. D. Shields; Expert Report of Ancil Taylor.

[19] The locks and dams laid out in the Expert Report of Ancil Taylor are considered.

[20] Expert Report of F. D. Shields; Expert Report of Ancil Taylor.

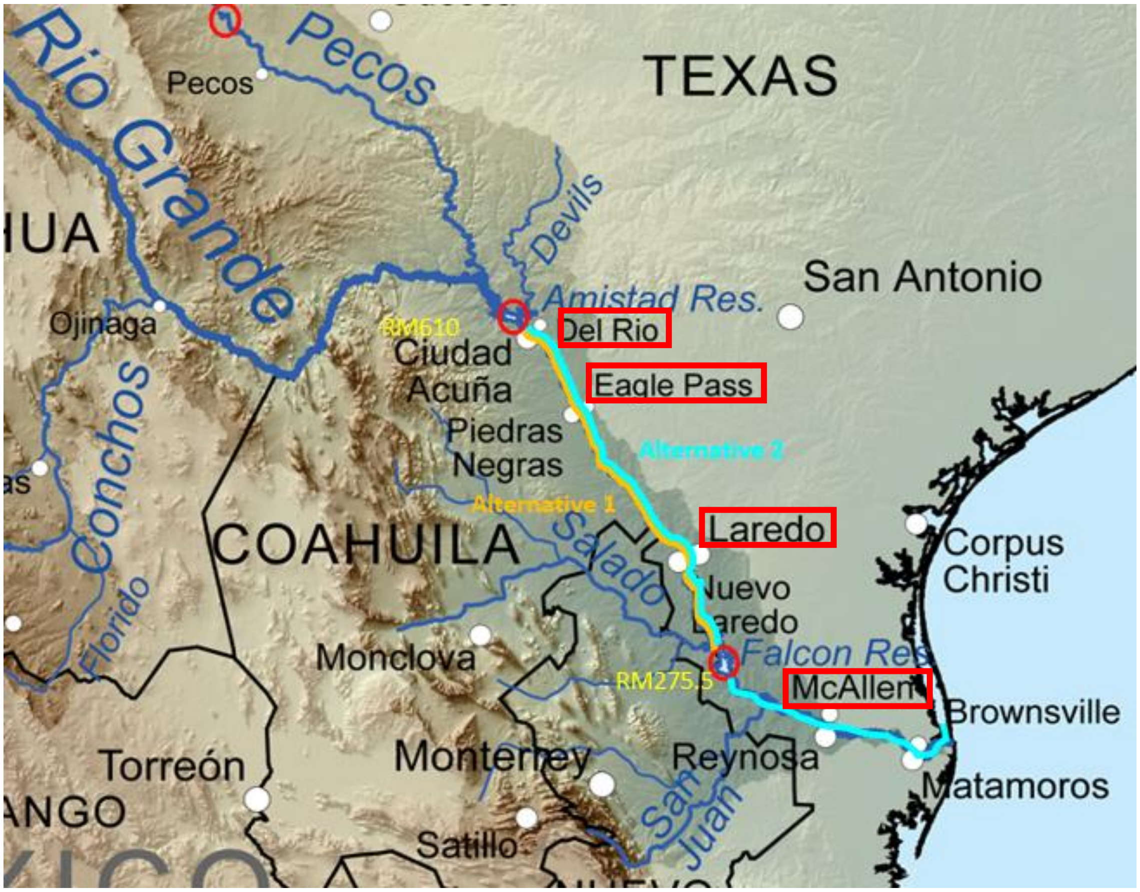

Figure 5 – The Routes of Two Canalized Alternatives and Hypothetical Ports Near Del Rio, Eagle Pass, Laredo, and McAllen.

37. There is a third alternative for the without-project condition, which is current condition without improvements for commercial navigation.

6 Cost and Benefit Estimates Assumptions

38. Since there is no detailed data defining the features, design, engineering and methods for the improvements, and no relevant studies have been performed in the past regarding the potential benefits, I have collected relevant data reported from various sources through my research online. The costs and benefits are estimated based on the data adjusted as needed using appropriate cost indices and considering the characteristics of the improvement alternatives for the Rio Grande. The assumptions used in the estimates are summarized as follows, while detailed explanations for the calculations are included in the attached quantum Schedule A:

Improvement Cost Estimates Assumptions

a) The improvement costs are estimated based on published cost data and comparable project cost information, which is generally corroborated by Mr. Ancil Taylor's analysis in terms of the order of magnitude. In Alternative 1, the improvement is between RM 610 and RM 275.5, which requires 30 new locks and dams. In Alternative 2, the improvement is from RM 610 to the Intracoastal Waterway, which requires 40 new locks and dams in addition to the existing Falcon Dam. Since there is an elevation gap of about 100 feet at the Falcon Dam, which is greater than that for the Panama Canal locks (85 feet),[21] five additional sets of new locks and dams are assumed.

b) At each lock/dam structure, a 600 cubic feet/second pump station is required for water recycling lifting the water by about 20 feet. At the Falcon Dam, five pump stations are needed in order to lift the water by 100 feet. Pump station construction costs are estimated based on a historical cost study included in Exhibit 7,[22] escalated to the date of this Expert Report.

c) It is assumed that the channel width is 250 feet, and on average 2,000 feet of land along the Rio Grande needs to be acquired at the average Texas land price.

d) In order to ship cargos on the improved channel, four inland ports are assumed to be constructed at Del Rio, Eagle Pass, Laredo, and McAllen, respectively, which are estimated based on the reported cost for a completed inland port.

e) Typical contingency range for Class 5 cost estimates is 40%-200%. In this analysis, 40% is assumed.

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[21] See Exhibit 15, "How the Water Locks of Panama Canal Work?"

[22] Exhibit 7, PDF page 39, an industry study on the relationship between construction costs and pump station capacity.

Operation and Maintenance Cost Estimates Assumptions

f) The annual operation and maintenance costs for river, locks and dams are estimated based on the 2023 budgeted cost per river mile for Mississippi River between Missouri River and Minneapolis, escalated to the date of this Expert Report.

g) The annual operation and maintenance costs for pump stations are estimated based on a historical cost study as included in Exhibit 7,[23] escalated to the date of this Expert Report.

h) The average annual operation and maintenance costs[24] for an inland port are adopted and escalated to the date of this Expert Report.

i) An annual increase of 2.6% is assumed for operation and maintenance costs, which is supported by USACE Cost Indices.

j) A contingency of 40% is also assumed for operation and maintenance costs.

Benefits Estimates Assumptions

k) Though the NED benefits for water resource development projects can include both navigation cost savings and flood control, flood control is not a benefit that the two improvement alternatives would bring, because the Rio Grande is facing a water scarcity.[25] Navigation transportation cost savings are the quantifiable NED benefit considered in this analysis.[26]

l) It is assumed that the four new inland ports at Del Rio, Eagle Pass, Laredo, and McAllen, as shown in Figure 5 and Figure 6, are able to handle all the cargo transfer between waterways and rails/highways.[27]

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23 Exhibit 7, PDF page 43, an industry study on the relationship between operation and maintenance costs and pump station capacity.

24 See Exhibit 22, "The Estimated Annual Cost to Operate a Port."

25 See Exhibit 4, "Valley's Water Scarcity Concerns Continue to Mount."

26 As demonstrated in a later section, the BCR's for the two alternatives are less than 1, which means that it is unnecessary to continue to consider RED, environmental, and social benefits.

27 If these ports do not have the capacity to handle the required cargoes, more ports would need to be built, which would in turn increase the construction costs, and operation and maintenance costs, and further reduce the Benefit to Cost ratios for the two alternatives.

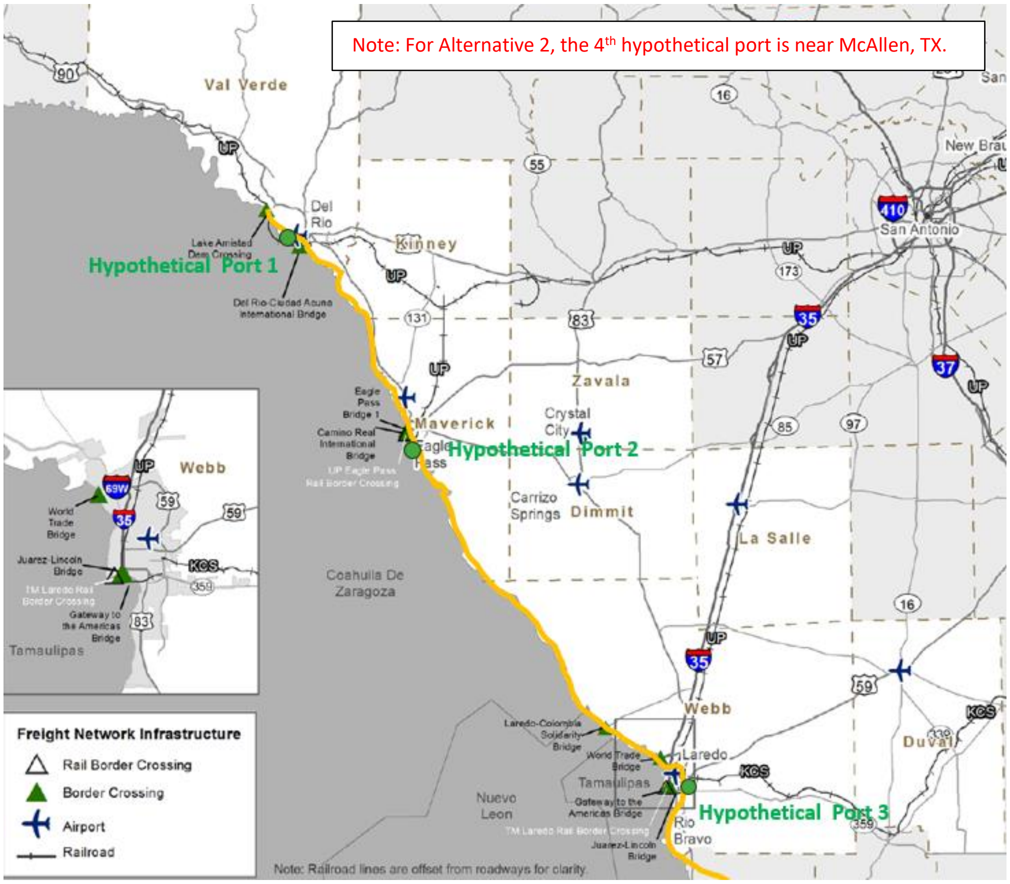

Figure 6 – Hypothetical Port Locations

m) The waterway from RM 610 to RM275.5 in Alternative 1 is isolated from other waterway systems. Cargos are transferred to barges from rails or trucks at one port and are transferred back to barges or trucks at another port to continue to the final destination, and thus a double handling of cargos would be incurred. It is assumed that 14%[28] of total freight tonnage in Laredo District is transferred to barges loaded and unloaded at the new Delta Rio, Eagle Pass and Laredo navigation ports. The double handling costs would offset the transportation cost savings in part. The cost savings per ton-mile is estimated based on a waterborne transportation cost saving study published by USACE,[29] while the wharfage charge for loading or unloading at Port of Corpus Christi is used to estimate the double handling costs.[30]

28 See Exhibit 5, per a study performed by Texas Transportation Institute, inland waterways account for 14% of all intercity freight.

29 See Exhibit 3, "Inland Waterway Navigation Value to the Nation."

30 See Exhibit 1, "Container Terminal and Cargo-Handling Cost Analysis Toolkit."

n) The waterway from RM 610 connecting to the Gulf Coast in Alternative 2 is connected to the Intracoastal Waterway, which in turn is connected to the waterways in the entire Mississippi River System. This would eliminate the double handling costs if cargos are shipped to the intracoastal waterway. It is assumed that 14% of total freight tonnage in Laredo District is transferred to barges loaded at the new Delta Rio, Eagle Pass and Laredo navigation ports, which would be shipped to the intercoastal waterway; 14% of total freight tonnage in Rio Grande Valley is transferred to barges loaded at the new McAllen port, in which half of them is shipped to the Laredo District with double handling incurred, and the other half of them is shipped to the intercoastal waterway. The cost savings per ton-mile is estimated based on the same approach used in Alternative 1 by relying on a USACE waterborne transportation cost saving study.

o) The growth of freight tonnage forecasted in the published transportation plans for Laredo District and Rio Grande Valley has been adopted.[31]

Present Value Analysis Assumptions

p) The study period is assumed to be 50 years, from 2024 to 2073.[32]

q) It is assumed that the construction period is 2024 and 2025. And the navigation system of the Rio Grande locks and dams is in operation starting from 2026.

r) The federal discount rate for fiscal year 2024 of 2.75% is adopted as the annual discount rate. [33]

[31] See Exhibits 17, "Rio Grande Valley Freight and Trade Transportation Plan," and 19, "Laredo District Profile, Texas Freight Mobility Plan 2018."

[32] See Exhibit 25, "USACE Feasibility Report Format and Content Guide," page 8.

[33] See Exhibit 16, "Federal Discount Rate for Fiscal Year 2024."

7 Benefit Cost Ratios

39. The calculated costs and benefits for Alternatives 1 and 2 are summarized in Figure 7, which are the incremental amount compared to the base condition, the alternative without improvement. Neither Alternative 1 or Alternative 2 provides a BCR that is greater than 1, or neither Alternative 1 nor Alternative 2 provides positive net incremental benefits. In particular, the BCR's for Alternatives 1 and 2 are 0.03 and 0.11, respectively, which are very low. This demonstrates that both Alternative 1 and Alternative 2 are far from being economically feasible.

40. It is worth noting that though Alternative 2 has a higher BCR compared to Alternative 1, the projected loss for Alternative 2 would be about $27 billion more than Alternative 1. This indicates that the potential benefits of extending the commercially navigable waterway from RM 275.5 to the intracoastal waterway would be outweighed significantly by the associated costs.

Benefit Cost Ratio Calculation			
	Without Improvement	Improvement Alternative 1	Improvement Alternative 2
	present value	present value	present value
Description	[1]	[2]	[3]
Incremental Costs	$0	$59,083,000,000	$95,020,000,000
Incremental Benefits	$0	$1,540,000,000	$10,185,000,000
Incremental Net Benefits	$0	($57,543,000,000)	($84,835,000,000)
Benefit Cost Ratio	N/A	0.03	0.11

[1] This alternative has no improvement.
[2] Alternative 1: A series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling.
[3] Alternative 2: A series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.

Figure 7 – Benefit Cost Ratio Calculation Results

8 Sensitivity Analysis

41. A sensitivity analysis is performed to assess the robustness of my findings on the economical feasibility of improving the Rio Grande for commercial navigation and evaluate the potential impact of uncertainties due to limited detailed data and information on the preliminary cost benefit analysis results. The sensitivity analysis results are summarized in Figure 8. As shown in Figure 8, in order for Alternatives 1 and 2 to break even, the costs need to be reduced by 97.4% and 89.3%, respectively; or the benefits need to increase by 3553.9% and 788.5%, respectively. Clearly, the finding of the economically infeasibility of Alternatives 1 and 2 is not sensitive to the granularity of data that can be available, and thus is robust. This high insensitivity also indicates that any practical variants for Alternatives 1 and 2 would not be economically feasible.

Sensitivity Analysis			
	Without Improvement	With Improvement Alternative 1	With Improvement Alternative 2
	present value	present value	present value
Description	[1]	[2]	[3]
Base Scenario			
Incremental Costs	$0	$59,083,000,000	$95,020,000,000
Incremental Benefits	$0	$1,540,000,000	$10,185,000,000
Incremental Net Benefit	$0	($57,543,000,000)	($84,835,000,000)
Benefit Cost Ratio	N/A	0.03	0.11
Scenario - Cost Reduction to Break Even			
Incremental Costs	$0	$59,083,000,000	$95,020,000,000
Required Cost Reduction to Change Recommendation		$57,543,000,000	$84,835,000,000
Required Cost Reduction %	$0	97.4%	89.3%
Scenario - Benefits Increase to Break Even			
Incremental Benefits	$0	$1,617,000,000	$10,694,250,000
Required Benefits Increase	$0	$57,466,000,000	$84,325,750,000
Required Benefits Increase %	N/A	3553.9%	788.5%

[1] This alternative has no improvement.
[2] Alternative 1: A series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling.
[3] Alternative 2: A series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.

Figure 8 – Sensitivity Analysis Results

9 Conclusions

42. Before a federal water resource project for achieving navigability on a river is able to start, a detailed feasibility study is needed. I am not aware that there is a feasibility study done by USACE or other parties for improving the Rio Grande to achieve commercial navigation, nor the detailed information compatible with the USACE requirements from public sources or produced by USA on this case which allow performing a detailed feasibility study.

43. A high-level cost-benefit analysis on potentially technically feasible improvement alternatives indicates that there are no technically feasible improvement alternatives to achieve commercial operation on the Rio Grande that are economically viable due to high construction, operation and maintenance costs and limited benefits.

10 Disclosures

10.1 List of Specific Documents Relied on By Expert

44. The specified documents I relied on are either included in the list of exhibits or noted in the footnotes of this Expert Report.

10.2 List of Publications Authored in the Prior 10 Years

45. The publications I authored in the prior 10 years include:

a) "Modeling Cumulative Impact of Changes: A Supplemental Note," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-1027, 2023 (sole author)

b) "Correlation and Causation in Construction Claims," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-979, 2023 (sole author)

c) "Sensitivity Study on Loss of Productivity Quantification Methods," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-917, 2023 (sole author)

d) "Timing and Severity of Cumulative Impact of Changes on Labor Productivity," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/(ASCE)LA.1943-4170.0000586, 2023 (sole author)

e) "Total Cost Claim versus Global Claim in Construction Claims," 2023 AACE International Transactions. (Primary author)

f) "Weather Impacts and Loss of Productivity Claims," Cost Engineering Journal, AACE, 2022, also in 2021 AACE International Transactions. (primary author)

g) "Recovering Loss of Productivity in Engineering," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2022 (primary author)

h) "Delay Claim Entitlement Under FIDIC Contracts," 2022 AACE International Transactions. (coauthor)

i) "Recovering Loss of Productivity Under FIDIC Contracts," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021 (sole author)

j) "Modeling with Functions for Cumulative Impact of Changes," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021 (sole author)

k) “Pilot Investigation of Underestimates: Likelihood, Severity, and Impact on Productivity,” Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021 (primary author)

l) “Dealing with Delay and Disruption on Construction Projects” Co-Authored Chapter 8 “Disruption – Technical” – on the subject of evaluation of causation and quantification methods. August 2020 (coauthor)

m) “Defending Against Loss of Productivity Claims” Source, AACE International, June 2020; also in 2019 AACE International Transactions (primary author)

n) “Loss of Productivity Analysis Using Project Specific Curves,” Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 11(4): 04519027, 2019. (primary author)

o) “Quantifying Lost Labor Productivity in Domestic and International Claims,” Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 10(3): 04518013, 2018 (primary author)

p) “Measured Mile Improvements in Pervasively Disrupted Projects,” 2017 AACE International Transactions. (primary author)

q) “Determining the Measured Mile for Lost Productivity Claims,” Source, AACE International, August 2016; also in 2015 AACE International Transactions (primary author)

r) “Finding the Elusive Measured Mile: Unconventional Case Studies,” 2016 AACE International Transactions (primary author)

s) “Calculating Lost Productivity: Is There a Better Way?” – Co-authored article published in The Construction Lawyer, Journal of the ABA Forum on Construction Law, Spring 2015 (coauthor)

t) “Proving Lost Productivity in International Construction Claims,” International Law Quarterly, Florida Bar, 2014 (primary author)

u) “Improved Baseline Method to Calculate Lost Construction Productivity,” Journal of Construction Engineering and Management, ASCE, 2014 (primary author)

v) “Lost Productivity - Finding the Missing Puzzle Pieces and Contract Bars,” 2014 AACE International Transactions (primary author)

10.3 List of Cases Expert Testified in As an Expert of Prior 4 Years

46. I provided deposition testimony in the following case in the prior 4 years:

Case	Date	Location
Evonne Bryant, et al. vs. City of Norfolk, et al.	2021	US District Court for the Eastern District of Virginia, Norfolk Division Deposition via Zoom

10.4 Expert Rate

47. The Office of the Attorney General of Texas is being billed at $810 per hour by the expert witness search and placement firm, ExpertConnect Litigation Support, LLC, who placed me on this matter and is responsible for all billing for my consultation services. My employer, Delta Consulting Group, retains 59.2% of that hourly rate amount for my expert consultation services.

48. The Office of the Attorney General of Texas is being billed at $810 per hour by the expert witness search and placement firm, ExpertConnect Litigation Support, LLC, who placed me on this matter and is responsible for all billing for my deposition and testimony services. My employer, Delta Consulting Group, retains 59.2% of that hourly rate amount for my expert deposition and testimony services.

11 Restrictions and Limitations

49. I understand that this Report will be used in the litigation to assist the trier of fact in determining the appropriate quantum decisions regarding economic feasibility. This Report is not to be used for any other purpose and we specifically disclaim any responsibility for losses or damages incurred through use of this Report for a purpose other than as described in this paragraph. It should not be reproduced in whole or in part without my express written permission.

50. I assumed that the information reviewed and relied upon was reasonably complete and accurate. Should any information provided to me not be accurate or correct, the findings expressed in this Report could change.

51. I reserve the right, but will be under no obligation, to review and/or revise the contents of this Report in light of information which becomes known to me after the date of this Report.

Respectfully Submitted by:
Delta Consulting Group, Inc.
4330 Prince William Pkwy
Suite 301
Woodbridge, VA 22192

By

Zhao Tong

Tong Zhao, Ph.D., PE, PSP, CCP, CFCC
Senior Director

June 14, 2024

DELTA
CONSULTING GROUP

Tong Zhao, PhD, PE, PSP, CCP, CFCC

Senior Director

T: 703-580-8801 **E:** tzhao@delta-cgi.com

Tong Zhao has broad experience in the engineering and construction of infrastructure, industrial, commercial, housing, and environmental projects. He has provided consulting services including CPM scheduling, forensic delay analysis, productivity analysis, cost estimating, forensic engineering, claim analysis and damage analysis on domestic and international construction projects, including natural gas power generation facilities, commercial housing/ buildings and World Bank funded large scale water diversion tunnels and dams.

Tong Zhao is a highly commended expert, thanks to his sterling work on domestic and cross-border forensic delay and damages briefs."

WWL- Experts - Construction- Quantum Delay & Technical

Selected Project Experience

▸ PRODUCTIVITY STUDY

- Performed labor productivity analysis and provided expert witness testimony on a $600 million long span bridge project in Central America.
- Performed labor productivity analysis on a 695MW hydroelectric power generation project in Canada.
- Performed labor productivity analysis and provided expert witness testimony on a $600 million long span bridge project in Central America.
- Prepared productivity impact analysis of a $1.4 billion light rail construction project in Arizona. Calculated damages using measured mile methodology and prepared expert report and presentation with supporting documentation that refuted contractor's claim.
- Prepared engineering productivity impact analysis of a $300 million chemical process plant project in the Middle East. Performed detailed analysis of numerous owner changes and directives to the design build contractor's design that resulted in cumulative impact to contractor's engineering productivity and schedule.
- Prepared labor productivity analysis for a runway project on an Air Force base in Asia to rebut the contractor's productivity loss claim.
- Performed the measured mile analysis to prove lost productivity in various domestic and international commercial building construction projects.
- Performed the measured mile analysis to prove lost productivity in an airport expansion project in Middle East.
- Performed the measured mile analysis to prove lost productivity in downtown development project consisting of multiple building blocks in Middle East.
- Performed productivity analyses to rebut disruption claims in various domestic and international infrastructure projects.

EDUCATION

- **University of Maryland**
  Ph.D. Civil Engineering, 2003
- **Tsinghua University**
  M.E. Hydraulic Structure (Construction Mgmt.), 1999
- **Tsinghua University**
  B.E. Construction (with Honors), 1996

CERTIFICATIONS & LICENSES

- Professional Engineer (PE) Maryland
- Planning and Scheduling Professional (PSP)
- Certified Cost Professional (CCP)
- Certified Forensic Claims Consultant (CFCC)

HONORS

Who's Who Legal:

- Thought Leaders, Construction 2021
- Consulting Experts, Construction Quantum, Delay & Technical 2018-2023
- Construction 2020-2023

2019 Best Paper Award, Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE

LANGUAGES

- English, Chinese

DELTA CONSULTING GROUP

Tong Zhao
PhD, PE, PSP, CCP, CFCC
CURRICULUM VITAE

▸ FORENSIC SCHEDULE ANALYSIS

- Prepared detailed critical path method (CPM) delay analysis on a wastewater treatment plant upgrade project in a northwestern state. Performed detailed as plan versus as built analysis, measuring and apportioning the delay caused by the subcontractor, prime contractor, and owner.
- Prepared schedule analysis demonstrating impact of differing site conditions on a power plant in Japan.
- Prepared detailed critical path delay analysis on a building project for a community college in Northern Virginia.
- Performed detailed CPM based schedule analysis to support contractor's claim of Owner caused delays on a commercial facility in Northern Virginia.
- Analyzed and apportioned the delay incurred during the design approval process in an Energy Saving Performance Contract (ESPC) project for a federal facility in a northeastern state.
- Conducted delay analysis on TBM tunneling in a $1.5 billion World Bank funded international water diversion project.
- Performed a CPM delay analysis for a combined cycle power plant project in Pennsylvania.
- Performed delay and damage analyses for a coal fired power plant project in West Virginia.
- Performed a CPM delay analysis for an international construction project involving two Floating Production Storage Offloading (FPSO) units overseas.

▸ COST ESTIMATING AND DAMAGE QUANTIFICATION

- Cost estimating and expert witness testimony on the probable costs for commercial/residential mixed-use buildings.
- Performed cost analysis and schedule analysis to help the client reach a settlement through mediation on a claim of about $200M associated with a delay of about a year in a rail construction project.
- Analyzed damage repair costs on several multi-story hotels and commercial buildings due to water intrusion, fire damages, or construction defects. Estimated and allocated damages to responsible parties.
- Developed and calculated damages for the owner due to the cost savings resulted from design changes to the dam and headrace tunnel in a $300 million mid-America hydroelectric project.
- Calculated the damages related to a dispute over the design build price for a 500MW combined cycle power plant in Florida.
- Quantified damages for delays and scope changes in a 150MW photovoltaic solar farm project in Midwest.

▸ PROJECT ADVISORY AND SCHEDULING

- Developed the baseline schedule and provided schedule update support for a cogeneration facility project in Japan.
- Maintained the completion construction schedule to the complete a power plant in Virginia.
- Developed and updated the completion construction schedule in a new worship facility project for a church located in Maryland.
- Prepared baseline schedules and schedule updates for various federal, state, and local government ESPC projects.
- Several engagements involving construction coordination, schedule preparation, and progress monitoring in international and domestic construction projects.

▸ FORENSIC ENGINEERING

- Performed slope stability analysis to find the root cause of the slope failure encountered during the construction of a commercial facility.
- Investigated the root cause for the installation issue of a prefabricated steel bridge trusses for a bridge in Virginia.
- Perform the hydraulic analysis to demonstrate the impact of the design changes on a headrace tunnel.
- Analyzed the root cause of the failure of the cofferdam during the construction of a water intake structure.

- Performed design change analysis for the fire protection system in a large-scale public facility.
- Analyzed the site development plans for several construction projects.

DESIGN/CONSTRUCTION ENGINEERING

- Conducted the preliminary design for the silt discharge structure and tunnels of the Five-Step Navigation Lock of Three Gorges Project.
- Evaluated the stresses and displacements of the plan gates of a reservoir.

AFFILIATIONS

- National Society of Professional Engineers
- AACE International
- American Society of Civil Engineers (ASCE)
- Committee of Claims Avoidance and Resolution, ASCE
- Committee of Loss of Productivity Measurement Standard, ASCE

EXPERT WITNESS TESTIMONY EXPERIENCE (DEPOSITION AND TRIAL)

CASE	DATE	LOCATION
Evonne Bryant, et al. vs. City of Norfolk, et al.	2021	US District Court for the Eastern Dis-trict of Virginia, Norfolk Division Falls Church, VA (via Zoom)
Puente Atlántico S.A. vs. Autoridad del Canal de Panamá	2018	ICC Arbitration – Panama City, Panama
Dulles Corridor Metrorail Project, Phase 2	2018	DRB Testimony – Dulles, VA
Morlando Construction, LLC vs. Asbury Automo-tive Group, Inc; Asbury Automotive North Carolina, LLC; and Crown Motorcar Company, LLC.	2015	Deposition Testimony – Washington, DC Arbitration Testimony – Charlotte, NC

JOURNAL PAPERS AND BOOK CHAPTERS

"Modeling Cumulative Impact of Changes: A Supplemental Note," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-1027, 2023

"Correlation and Causation in Construction Claims," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-979, 2023

"Sensitivity Study on Loss of Productivity Quantification Methods," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/JLADAH.LADR-917, 2023

"Timing and Severity of Cumulative Impact of Changes on Labor Productivity," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, DOI: 10.1061/(ASCE)LA.1943-4170.0000586, 2023

"Weather Impacts and Loss of Productivity Claims," Cost Engineering Journal, AACE, 2022

"Recovering Loss of Productivity in Engineering," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2022

"Recovering Loss of Productivity Under FIDIC Contracts," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021

"Modeling with Functions for Cumulative Impact of Changes," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021

"Pilot Investigation of Underestimates: Likelihood, Severity, and Impact on Productivity," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 2021

"Dealing with Delay and Disruption on Construction Projects" Co-Authored Chapter 8 "Disruption – Technical" – on the subject of evaluation of causation and quantification methods. August 2020

"Defending Against Loss of Productivity Claims" Source, AACE International, June 2020

"Loss of Productivity Analysis Using Project Specific Curves," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 11(4): 04519027, 2019.

"Quantifying Lost Labor Productivity in Domestic and International Claims," Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, ASCE, 10(3): 04518013, 2018

"Determining the Measured Mile for Lost Productivity Claims," Source, AACE International, August 2016

"Calculating Lost Productivity: Is There a Better Way?" – Co-authored article published in The Construction Lawyer, Journal of the ABA Forum on Construction Law, Spring 2015

"Proving Lost Productivity in International Construction Claims," International Law Quarterly, Florida Bar, 2014

"Improved Baseline Method to Calculate Lost Construction Productivity," Journal of Construction Engineering and Management, ASCE, 2014

"Expert Witness: Construction Cases" Co-Authored Chapter 10 "Productivity Expert" - on the subject of using experts in construction productivity damage cases. October 2011

"Contingency Estimation Using a Real Options Approach," Construction Management and Economics, 2009

"Flexible Facility Interior Layout: A Real Options Approach," Journal of the Operational Research Society, 2007

"Infrastructure Development and Expansion Under Uncertainty: A Risk Preference Based Lattice Approach," Journal of Construction Engineering and Management, ASCE, 2006

"Highway Development Decision-making Under Uncertainty: A Real Options Approach," Journal of Infrastructure Systems, ASCE, 2004

"A Note on Activity Floats in Activity-on-arrow Networks," Journal of the Operational Research Society, 2003

"Valuing Flexibility in Infrastructure Expansion," Journal of Infrastructure Systems, ASCE, 2003

► SPEAKING ENGAGEMENTS/CONFERENCE PROCEEDINGS

"Resolving Construction Disputes on Loss of Productivity," virtual seminar for AACE International San Francisco Section, 2024.

"Introduction to Forensic Schedule Analysis," virtual seminar for AACE International San Francisco Section; also presented at AACE International Northeast Symposium, 2024.

"Total Cost Claim versus Global Claim in Construction Claims," presented at 2023 AACE International Conference & Expo; also in 2023 AACE International Transactions.

"Overtime and Loss of Productivity Claims," presented at 2022 AACE International Conference & Expo; also in 2022 AACE International Transactions.

"Delay Claim Entitlement Under FIDIC Contracts," presented at 2022 AACE International Conference & Expo; also in 2022 AACE International Transactions.

"Working as an Expert Witness in the US," virtual seminar for Beijing Construction Engineering Bidding and Cost Association, 2022.

"Quantifying Lost Labor Productivity in Domestic and International Claims," virtually presented at AACE Peru Section the 9th International Congress of Cost Engineering, 2021

"Litigating Lost Productivity Claims in Construction: Developing Methodologies, ASCE Standards," Strafford webinar, 2021

"Modeling with Functions for Cumulative Impact of Changes," virtually presented at 2021 International LADR Workshop, Cairo, Egypt.

"Weather Impacts and Loss of Productivity Claims," recorded webinar for 2021 AACE International Conference & Expo; also in 2021 AACE International Transactions.

"Defending Against Loss of Productivity Claims," presented at 2019 AACE International Conference & Expo, New Orleans, LA; also in 2019 AACE International Transactions.

"Loss of Productivity Analysis Using Project Specific Curves," presented at ASCE CI Summit 2019, Atlanta, GA.

"Quantifying Lost Labor Productivity in Domestic and International Claims," presented at ASCE CI Summit 2018, Fort Worth, TX.

"Measured Mile Improvements in Pervasively Disrupted Projects," presented at 2017 AACE International Annual Meeting, Orlando, FL; also in 2017 AACE International Transactions.

"Finding the Elusive Measured Mile: Unconventional Case Studies," presented at 2016 AACE International Annual Meeting, Toronto, Canada; also in 2016 AACE International Transactions.

"Determining the Measured Mile for Lost Productivity Claims," presented at 2015 AACE International Annual Meeting, Las Vegas, NV; also in 2015 AACE International Transactions.

"Lost Productivity - Finding the Missing Puzzle Pieces and Contract Bars," presented at 2014 AACE International Annual Meeting, New Orleans, LA; also in 2014 AACE International Transactions.

"Avoiding the Pitfalls in Implementing the Measured Mile Method," presented at 2013 AACE International Annual Meeting, Washington, DC; also in 2013 AACE International Transactions.

"Proving Engineering Productivity Loss," presented at the 2012 AACE International Annual Meeting, San Antonio; also in 2012 AACE International Transactions.

USA vs. Abbott
Schedule A

Benefit Cost Ratio Calculation	Without Improvement	Improvement Alternative 1	Improvement Alternative 2	
	present value	present value	present value	
Description	[1]	[2]	[3]	**Schedule Reference**
Incremental Costs	$0	$59,083,000,000	$95,020,000,000	Schedule A-1
Incremental Benefits	$0	$1,540,000,000	$10,185,000,000	Schedule A-2
Incremental Net Benefits	$0	($57,543,000,000)	($84,835,000,000)	
Benefit Cost Ratio	N/A	0.03	0.11	

[1] This alternative has no improvement.
[2] Alternative 1: A series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling.
[3] Alternative 2: A series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.

USA vs. Abbott
Schedule A-1

Present Value of Costs					Alternative 1		Alternative 2	
No.	**Fiscal Year**	**Description**	**Discount Factor**	**Cost Increase Factor**	**Cost**	**Present Value in 2024**	**Cost**	**Present Value in 2024**
			[1]	[2]	[3]	[4]	[5]	[6]
1	2024	Construction Costs	100.00%	100.00%	$25,664,469,485	$25,664,469,485	$40,727,939,254	$40,727,939,254
2	2025	Construction Costs	97.32%	100.00%	$25,664,469,485	$24,977,585,873	$40,727,939,254	$39,637,897,084
3	2026	Operation and Maintenance Costs	94.72%	102.60%	$192,108,815	$181,963,227	$333,513,686	$315,900,272
4	2027	Operation and Maintenance Costs	92.18%	102.60%	$197,103,644	$181,697,588	$342,185,042	$315,439,104
5	2028	Operation and Maintenance Costs	89.72%	102.60%	$202,228,338	$181,432,336	$351,081,853	$314,978,609
6	2029	Operation and Maintenance Costs	87.32%	102.60%	$207,486,275	$181,167,471	$360,209,982	$314,518,786
7	2030	Operation and Maintenance Costs	84.98%	102.60%	$212,880,918	$180,902,993	$369,575,441	$314,059,634
8	2031	Operation and Maintenance Costs	82.70%	102.60%	$218,415,822	$180,638,901	$379,184,403	$313,601,153
9	2032	Operation and Maintenance Costs	80.49%	102.60%	$224,094,634	$180,375,194	$389,043,197	$313,143,341
10	2033	Operation and Maintenance Costs	78.34%	102.60%	$229,921,094	$180,111,873	$399,158,320	$312,686,198
11	2034	Operation and Maintenance Costs	76.24%	102.60%	$235,899,043	$179,848,936	$409,536,436	$312,229,721
12	2035	Operation and Maintenance Costs	74.20%	102.60%	$242,032,418	$179,586,383	$420,184,384	$311,773,912
13	2036	Operation and Maintenance Costs	72.21%	102.60%	$248,325,261	$179,324,213	$431,109,178	$311,318,767
14	2037	Operation and Maintenance Costs	70.28%	102.60%	$254,781,717	$179,062,426	$442,318,016	$310,864,287
15	2038	Operation and Maintenance Costs	68.40%	102.60%	$261,406,042	$178,801,021	$453,818,285	$310,410,471
16	2039	Operation and Maintenance Costs	66.57%	102.60%	$268,202,599	$178,539,997	$465,617,560	$309,957,317
17	2040	Operation and Maintenance Costs	64.79%	102.60%	$275,175,867	$178,279,355	$477,723,617	$309,504,824
18	2041	Operation and Maintenance Costs	63.05%	102.60%	$282,330,439	$178,019,093	$490,144,431	$309,052,992
19	2042	Operation and Maintenance Costs	61.37%	102.60%	$289,671,031	$177,759,211	$502,888,186	$308,601,820
20	2043	Operation and Maintenance Costs	59.72%	102.60%	$297,202,477	$177,499,709	$515,963,279	$308,151,307
21	2044	Operation and Maintenance Costs	58.13%	102.60%	$304,929,742	$177,240,585	$529,378,324	$307,701,451
22	2045	Operation and Maintenance Costs	56.57%	102.60%	$312,857,915	$176,981,840	$543,142,161	$307,252,252
23	2046	Operation and Maintenance Costs	55.06%	102.60%	$320,992,221	$176,723,472	$557,263,857	$306,803,708
24	2047	Operation and Maintenance Costs	53.58%	102.60%	$329,338,019	$176,465,482	$571,752,717	$306,355,819
25	2048	Operation and Maintenance Costs	52.15%	102.60%	$337,900,807	$176,207,868	$586,618,288	$305,908,585
26	2049	Operation and Maintenance Costs	50.75%	102.60%	$346,686,228	$175,950,630	$601,870,363	$305,462,003
27	2050	Operation and Maintenance Costs	49.39%	102.60%	$355,700,070	$175,693,768	$617,518,993	$305,016,073
28	2051	Operation and Maintenance Costs	48.07%	102.60%	$364,948,272	$175,437,281	$633,574,486	$304,570,794
29	2052	Operation and Maintenance Costs	46.79%	102.60%	$374,436,927	$175,181,168	$650,047,423	$304,126,165
30	2053	Operation and Maintenance Costs	45.53%	102.60%	$384,172,287	$174,925,429	$666,948,656	$303,682,185
31	2054	Operation and Maintenance Costs	44.31%	102.60%	$394,160,766	$174,670,063	$684,289,321	$303,238,854
32	2055	Operation and Maintenance Costs	43.13%	102.60%	$404,408,946	$174,415,070	$702,080,843	$302,796,169
33	2056	Operation and Maintenance Costs	41.97%	102.60%	$414,923,579	$174,160,450	$720,334,945	$302,354,131
34	2057	Operation and Maintenance Costs	40.85%	102.60%	$425,711,592	$173,906,201	$739,063,654	$301,912,738
35	2058	Operation and Maintenance Costs	39.76%	102.60%	$436,780,093	$173,652,323	$758,279,309	$301,471,990
36	2059	Operation and Maintenance Costs	38.69%	102.60%	$448,136,376	$173,398,816	$777,994,571	$301,031,884
37	2060	Operation and Maintenance Costs	37.66%	102.60%	$459,787,922	$173,145,679	$798,222,430	$300,592,422
38	2061	Operation and Maintenance Costs	36.65%	102.60%	$471,742,408	$172,892,912	$818,976,213	$300,153,601
39	2062	Operation and Maintenance Costs	35.67%	102.60%	$484,007,710	$172,640,514	$840,269,595	$299,715,420
40	2063	Operation and Maintenance Costs	34.71%	102.60%	$496,591,911	$172,388,484	$862,116,604	$299,277,880
41	2064	Operation and Maintenance Costs	33.79%	102.60%	$509,503,300	$172,136,822	$884,531,636	$298,840,978
42	2065	Operation and Maintenance Costs	32.88%	102.60%	$522,750,386	$171,885,527	$907,529,458	$298,404,713
43	2066	Operation and Maintenance Costs	32.00%	102.60%	$536,341,896	$171,634,599	$931,125,224	$297,969,086
44	2067	Operation and Maintenance Costs	31.14%	102.60%	$550,286,785	$171,384,038	$955,334,480	$297,534,095
45	2068	Operation and Maintenance Costs	30.31%	102.60%	$564,594,242	$171,133,842	$980,173,176	$297,099,738
46	2069	Operation and Maintenance Costs	29.50%	102.60%	$579,273,692	$170,884,012	$1,005,657,679	$296,666,016
47	2070	Operation and Maintenance Costs	28.71%	102.60%	$594,334,808	$170,634,546	$1,031,804,779	$296,232,927
48	2071	Operation and Maintenance Costs	27.94%	102.60%	$609,787,513	$170,385,444	$1,058,631,703	$295,800,470
49	2072	Operation and Maintenance Costs	27.19%	102.60%	$625,641,989	$170,136,706	$1,086,156,127	$295,368,645
50	2073	Operation and Maintenance Costs	26.47%	102.60%	$641,908,680	$169,888,332	$1,114,396,187	$294,937,450
		Total				**$59,083,247,185**		**$95,020,307,092**

[1] See Exhibit 16. The discount factor is calculated based on Federal Discount Rate for Fiscal Year 2024 of 2.75%.
[2] See Exhibit 13. The average annual cost escalation from 2023 to 2055 is at 2.6% (=(2614/1144.03)^(1/(2055-2023))-1).
[3] Estimated cost adjusted by cost increase factor for Alternative 1.
[4] Present value of estimated cost for Alternative 1.
[5] Estimated cost adjusted by cost increase factor for Alternative 2.
[6] Present value of estimated cost for Alternative 2.

USA vs. Abbott
Schedule A-1.1

Construction Costs											
			Alternative 1				Alternative 2				
Description	Unit Cost		Quantity	Unit		Costs	Quantity	Unit		Costs
Dredging and Bank Stabilization										
Dredging Costs	$ 36	[1]	52,587,787	CY	[2]	$ 1,882,266,318	95,900,000	CY	[2]	$ 3,432,533,495
Bank Stabilization/Levee Costs	$ 725	[1]	10,596,960	LF	[2]	$ 7,684,671,141	19,324,800	LF	[2]	$ 14,013,899,539
Land Acquisition Costs	$ 4,781	[1]	81,091	ACRE	[3]	$ 387,718,097	147,879	ACRE	[4]	$ 707,049,444
Infrastructure Improvements										
Falcon Dam Modification & Locks	$ 3,753,715,562	[4]					1	EA	[2]	$ 3,753,715,562
Locks/Dams	$ 750,743,112	[1]	30	EA	[2]	$ 22,522,293,371	40	EA	[2]	$ 30,029,724,495
Inland Ports	$ 68,041,072	[1]	3	EA	[2]	$ 204,123,216	4	EA	[2]	$ 272,164,287
Pump Stations	$ 132,748,523	[1]	30	EA	[2]	$ 3,982,455,693	45	EA	[2]	$ 5,973,683,539
Subtotal						$ 36,663,527,836				$ 58,182,770,362
Contingency for Unknowns and Misc. @ 40%						$ 14,665,411,134				$ 23,273,108,145
Total						**$ 51,328,938,970**				**$ 81,455,878,507**
Rounded Number						$ 51,329,000,000				$ 81,456,000,000

[1] Schedule A-1.1.1.
[2] See Sections 5 and 6 of the main expert report. The dredging quantities are based on the quantity takeoff performed by Mr. Ancil Taylor.
[3] 2,000ft wide and 334.5 miles long
[4] 2,000ft wide and 610 miles long
[5] The required lift at Falcon Dam is 100 feet, while the lift of the Panama Canal is only 85 feet. Lock structures that needs to be built at Falcon dam could be comparable with the lock structures at the Panama Canal. It is assumed that 5 locks/dams with a lift of 20 feet each need to be built ($750,743,112X5=$3,753,715,562)

USA vs. Abbott
Schedule A-1.1.1

Construction Unit Cost for Corroborations

Description	Unit	Reference Unit Cost		Reference (Fiscal) Year/Quarter	Reference Fiscal Year Cost Index	2024/Q3 Cost Index	Indirect Factor		Costs
Dredging and Bank Stabilization									
Dredging Costs	CY	$ 16.25	[1]	2017/Q4	845.51	1,171.29	159%	[2]	$ 35.79
Bank Stabilization/Levee Costs	LF	$ 450.00	[3]	2024/Q1	1,155.66	1,171.29	159%	[2]	$ 725.18
Land Acquisition Costs	ACRE	$ 4,670.00	[4]	2023/Q4	1,144.03	1,171.29	100%		$ 4,781.28
Infrastructure Improvements									
Locks/Dams	EA	$ 740,725,000.00	[5]	2024/Q1	1,155.66	1,171.29	100%		$ 750,743,112.38
Inland Ports	EA	$ 50,500,000.00	[6]	2018/Q3	869.33	1,171.29	100%		$ 68,041,071.86
Pump Stations	EA	$ 80,000,000.00	[7]	2008/Q4	705.87	1,171.29	100%		$ 132,748,523.10

[1] See Exhibit 11, the average new dredging cost for USACE projects in 2017 is $16.25CY.
[2] See Exhibit 8, 59% of direct costs can be used to estimate as the amount for indirect costs.
[3] See Exhibit 10, it is assumed that levees/ripraps need to installed in part of the stretch of the river. Therefore, repair cost, instead of new installation cost is used to apply to the length of the stretch, to be conservative. Per Exhibit 9, new construction rate can be more than $3,000/ft.
[4] See Exhibit 14. The average cost of land per acre is $4,670 as of Q4 2023.
[5] See Exhibit 12. The locks/dams are assumed to be similar to Upper Mississippi River Lock 20 ($624M), Lock 21 ($749.9M), Lock 22 ($727.0M), and Lock 23 ($862.0M). The average is about $740.7M.
[6] See Exhibit 6. The inland port cost can be $50.5M.
[7] In order to conserve the water used for lock operation, a 600 cubic feet/sec (or 322 MGD) pump station is needed to lift the water by 20 feet. Per the curve modeling the relationship between construction cost and pump station capacity in Exhibit 7 (PDF page 39), a 600 cubic feet/sec pump is estimated to cost $80M as of Q4 2008.

USA vs. Abbott
Schedule A-1.2

Operation and Maintenance Costs															
				Alternative 1						Alternative 2					
Description		Unit Cost		Quantity	Unit			Costs		Quantity	Unit			Costs	
Infrastructure O&M															
River, Locks & Dams	$	293,868	[1]	334.5	RM	[2]	$	98,298,844		610	RM	[3]	$	179,259,477	
Inland Ports	$	2,077,959	[1]	3	EA		$	6,233,877		4	EA		$	8,311,835	
Pump Stations	$	860,711	[1]	30	EA		$	25,821,331		45	EA		$	38,731,996	
Sub Total							$	130,354,052					$	226,303,309	
Contingency for Unknowns and Misc. @ 40%							$	52,141,621					$	90,521,323	
Total							**$**	**182,495,672**					**$**	**316,824,632**	

[1] Schedule A-1.2.1
[2] RM 610 to 275.5
[3] RM 610 to 0

USA vs. Abbott
Schedule A-1.2.1
Operation and Maintenance Unit Cost

Description	Unit	Reference Unit Cost		Reference (Fiscal) Year/Quarter	Reference Fiscal Year Cost Index	2024/Q3 Cost Index	Indirect Factor	Costs
Infrastructure O&M								
River, Locks & Dams	River Mile	$ 287,028.66	[1]	2023/Q4	1,144.03	1,171.29	100%	$ 293,867.99
Inland Ports	EA	$ 1,500,000.00	[2]	2017/Q4	845.51	1,171.29	100%	$ 2,077,958.87
Pump Stations	EA	$ 500,000.00	[3]	2007/Q4	680.42	1,171.29	100%	$ 860,711.03

[1] See Exhibits 20 and 21. The operation and maintenance costs for river, locks and dams are estimated based on the budget cost per river mile for Mississippi River between Missouri River and Minneapolis.
[2] See Exhibit 22.
[3] See Exhibit 7. Per the curves modeling the relationship between O&M costs and pump station capacity in Exhibit 7 (PDF page 43), a 600 cubic feet/sec (or 322MGD) pump is estimated to cost $250,000 for labor and equipment/materials each as of Q4 2007.

USA vs. Abbott
Schedule A-2

						Present Value of Benefits					
						Alternative 1		Alternative 2			
No.	Fiscal Year	Description	Discount Factor	Laredo District Demand Increase	Rio Grande Valley Demand Increase	Benefits	Present Value in 2024	Laredo District Benefits	Rio Grande Valley Benefits	Total Benefits	Present Value in 2024
			[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1	2024	In Construction	100.00%			$0	$0	$0	$0	$0	$0
2	2025	In Construction	97.32%			$0	$0	$0	$0	$0	$0
3	2026	Transportation Cost Savings	94.72%	105.27%	106.38%	$35,044,104	$33,193,366	$189,406,404	$37,415,868	$226,822,272	$214,843,409
4	2027	Transportation Cost Savings	92.18%	102.60%	103.14%	$35,955,250	$33,144,909	$194,330,971	$38,590,726	$232,921,697	$214,716,023
5	2028	Transportation Cost Savings	89.72%	102.60%	103.14%	$36,890,087	$33,096,522	$199,383,576	$39,802,475	$239,186,051	$214,589,529
6	2029	Transportation Cost Savings	87.32%	102.60%	103.14%	$37,849,229	$33,048,206	$204,567,549	$41,052,273	$245,619,822	$214,463,929
7	2030	Transportation Cost Savings	84.98%	102.60%	103.14%	$38,833,309	$32,999,960	$209,886,305	$42,341,314	$252,227,619	$214,339,226
8	2031	Transportation Cost Savings	82.70%	102.60%	103.14%	$39,842,975	$32,951,785	$215,343,349	$43,670,831	$259,014,180	$214,215,419
9	2032	Transportation Cost Savings	80.49%	102.60%	103.14%	$40,878,892	$32,903,680	$220,942,276	$45,042,095	$265,984,372	$214,092,511
10	2033	Transportation Cost Savings	78.34%	102.60%	103.14%	$41,941,744	$32,855,646	$226,686,775	$46,456,417	$273,143,193	$213,970,502
11	2034	Transportation Cost Savings	76.24%	102.60%	103.14%	$43,032,229	$32,807,681	$232,580,631	$47,915,149	$280,495,780	$213,849,395
12	2035	Transportation Cost Savings	74.20%	102.60%	103.14%	$44,151,067	$32,759,787	$238,627,728	$49,419,684	$288,047,412	$213,729,191
13	2036	Transportation Cost Savings	72.21%	102.60%	103.14%	$45,298,995	$32,711,962	$244,832,049	$50,971,463	$295,803,511	$213,609,891
14	2037	Transportation Cost Savings	70.28%	102.60%	103.14%	$46,476,769	$32,664,208	$251,197,682	$52,571,966	$303,769,648	$213,491,496
15	2038	Transportation Cost Savings	68.40%	102.60%	103.14%	$47,685,165	$32,616,523	$257,728,822	$54,222,726	$311,951,548	$213,374,009
16	2039	Transportation Cost Savings	66.57%	102.60%	103.14%	$48,924,979	$32,568,907	$264,429,771	$55,925,320	$320,355,091	$213,257,430
17	2040	Transportation Cost Savings	64.79%	102.60%	103.14%	$50,197,028	$32,521,361	$271,304,945	$57,681,375	$328,986,320	$213,141,761
18	2041	Transportation Cost Savings	63.05%	102.60%	103.14%	$51,502,151	$32,473,885	$278,358,874	$59,492,570	$337,851,444	$213,027,004
19	2042	Transportation Cost Savings	61.37%	102.60%	103.14%	$52,841,207	$32,426,478	$285,596,204	$61,360,637	$346,956,841	$212,913,160
20	2043	Transportation Cost Savings	59.72%	102.60%	103.14%	$54,215,078	$32,379,140	$293,021,706	$63,287,361	$356,309,066	$212,800,230
21	2044	Transportation Cost Savings	58.13%	102.60%	103.14%	$55,624,670	$32,331,871	$300,640,270	$65,274,584	$365,914,854	$212,688,216
22	2045	Transportation Cost Savings	56.57%	102.60%	103.14%	$57,070,912	$32,284,671	$308,456,917	$67,324,206	$375,781,123	$212,577,120
23	2046	Transportation Cost Savings	55.06%	102.60%	103.14%	$58,554,755	$32,237,540	$316,476,797	$69,438,186	$385,914,983	$212,466,942
24	2047	Transportation Cost Savings	53.58%	102.60%	103.14%	$60,077,179	$32,190,478	$324,705,194	$71,618,545	$396,323,739	$212,357,686
25	2048	Transportation Cost Savings	52.15%	102.60%	103.14%	$61,639,186	$32,143,485	$333,147,529	$73,867,367	$407,014,896	$212,249,351
26	2049	Transportation Cost Savings	50.75%	102.60%	103.14%	$63,241,805	$32,096,560	$341,809,364	$76,186,803	$417,996,167	$212,141,940
27	2050	Transportation Cost Savings	49.39%	102.60%	103.14%	$64,886,091	$32,049,704	$350,696,408	$78,579,068	$429,275,476	$212,035,454
28	2051	Transportation Cost Savings	48.07%	102.60%	103.14%	$66,573,130	$32,002,916	$359,814,515	$81,046,451	$440,860,965	$211,929,895
29	2052	Transportation Cost Savings	46.79%	102.60%	103.14%	$68,304,031	$31,956,196	$369,169,692	$83,591,309	$452,761,001	$211,825,264
30	2053	Transportation Cost Savings	45.53%	102.60%	103.14%	$70,079,936	$31,909,545	$378,768,104	$86,216,077	$464,984,180	$211,721,563
31	2054	Transportation Cost Savings	44.31%	102.60%	103.14%	$71,902,014	$31,862,962	$388,616,075	$88,923,261	$477,539,336	$211,618,794
32	2055	Transportation Cost Savings	43.13%	102.60%	103.14%	$73,771,467	$31,816,446	$398,720,093	$91,715,452	$490,435,544	$211,516,958
33	2056	Transportation Cost Savings	41.97%	102.60%	103.14%	$75,689,525	$31,769,999	$409,086,815	$94,595,317	$503,682,132	$211,416,056
34	2057	Transportation Cost Savings	40.85%	102.60%	103.14%	$77,657,453	$31,723,619	$419,723,072	$97,565,610	$517,288,682	$211,316,091
35	2058	Transportation Cost Savings	39.76%	102.60%	103.14%	$79,676,546	$31,677,308	$430,635,872	$100,629,170	$531,265,042	$211,217,064
36	2059	Transportation Cost Savings	38.69%	102.60%	103.14%	$81,748,137	$31,631,063	$441,832,405	$103,788,926	$545,621,331	$211,118,976
37	2060	Transportation Cost Savings	37.66%	102.60%	103.14%	$83,873,588	$31,584,887	$453,320,047	$107,047,898	$560,367,945	$211,021,830
38	2061	Transportation Cost Savings	36.65%	102.60%	103.14%	$86,054,301	$31,538,777	$465,106,368	$110,409,202	$575,515,571	$210,925,627
39	2062	Transportation Cost Savings	35.67%	102.60%	103.14%	$88,291,713	$31,492,735	$477,199,134	$113,876,051	$591,075,185	$210,830,368
40	2063	Transportation Cost Savings	34.71%	102.60%	103.14%	$90,587,298	$31,446,761	$489,606,312	$117,451,759	$607,058,071	$210,736,055
41	2064	Transportation Cost Savings	33.79%	102.60%	103.14%	$92,942,567	$31,400,853	$502,336,076	$121,139,744	$623,475,820	$210,642,690
42	2065	Transportation Cost Savings	32.88%	102.60%	103.14%	$95,359,074	$31,355,012	$515,396,814	$124,943,532	$640,340,346	$210,550,275
43	2066	Transportation Cost Savings	32.00%	102.60%	103.14%	$97,838,410	$31,309,238	$528,797,131	$128,866,759	$657,663,890	$210,458,812
44	2067	Transportation Cost Savings	31.14%	102.60%	103.14%	$100,382,209	$31,263,532	$542,545,856	$132,913,176	$675,459,032	$210,368,301
45	2068	Transportation Cost Savings	30.31%	102.60%	103.14%	$102,992,146	$31,217,891	$556,652,048	$137,086,649	$693,738,698	$210,278,745
46	2069	Transportation Cost Savings	29.50%	102.60%	103.14%	$105,669,942	$31,172,318	$571,125,002	$141,391,170	$712,516,172	$210,190,146
47	2070	Transportation Cost Savings	28.71%	102.60%	103.14%	$108,417,361	$31,126,811	$585,974,252	$145,830,853	$731,805,105	$210,102,504
48	2071	Transportation Cost Savings	27.94%	102.60%	103.14%	$111,236,212	$31,081,370	$601,209,582	$150,409,942	$751,619,524	$210,015,823
49	2072	Transportation Cost Savings	27.19%	102.60%	103.14%	$114,128,353	$31,035,996	$616,841,031	$155,132,814	$771,973,845	$209,930,104
50	2073	Transportation Cost Savings	26.47%	102.60%	103.14%	$117,095,691	$30,990,688	$632,878,898	$160,003,984	$792,882,882	$209,845,348
		Total					$1,539,825,238				$10,184,518,112

[1] See Exhibit 16. The discount factor is calculated based on Federal Discount Rate for Fiscal Year 2024 of 2.75%.
[2] Schedule A-2.1.2.
[3] Schedule A-2.1.2.
[4] Estimated benefit adjusted by demand increase factor for Alternative 1.
[5] Present value of estimated benefit for Alternative 1.
[6] Estimated benefit from Laredo District adjusted by demand increase for Alternative 2.
[7] Estimated benefit from Rio Grande Valley adjusted by demand increase for Alternative 2.
[8] Estimated total benefit adjusted by demand increase factor for Alternative 2.
[9] Present value of estimated benefit for Alternative 2.

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Schedule A-2.1

Benefits in 2024 if in Operation											
				Alternative 1				Alternative 2			
Description	Unit Cost	Unit		Tonnage	Average Distance (miles)		Cost Savings	Tonnage	Average Distance (miles)		Cost Savings
Alternative 1 - Transportation Cost Savings	$ 0.04	$/Ton-mile	[1]	9,160,368	167.3	[2]	$ 67,968,470				
Offset by Double Handling(Loading&Unloading)	$ (3.79)	$/Ton	[1]	9,160,368			$ (34,677,976)				
Alternative 1 Net Cost Savings							$ 33,290,494				
Alternative 2 - Transportation Cost Savings (Laredo District)	$ 0.04	$/Ton-mile	[1]					9,160,368	442.8	[3]	$ 179,928,491
Alternative 2 - Transportation Cost Savings (Rio Grande Valley to IntraCoastal)	$ 0.04	$/Ton-mile	[1]					5,755,479	137.8	[4]	$ 35,172,365
Alternative 2 - Rio Grande (to Laredo District) Savings Calculation											
Savings (Rio Grande Valley to Laredo District)	$ 0.04	$/Ton-mile	[1]					5,755,479	305.0	[5]	$ 77,877,106
Alternative 2 - Offset by Double Handling (Rio Grande Valley to Laredo District)	$ (3.79)	$/Ton-mile	[1]					5,755,479			$ (21,788,250)
Alternative 2 - Savings Total											$ 271,189,712

[1] Schedule A-2.1.1.
[2] Half of the distance of RM 610-275.5
[3] Half of the distance of RM 610-275.5, plus 275.5.
[4] Half of the distance of RM 275.5-0. It is assumed that half of waterborne tonnage in Rio Grande Valley is to Laredo District (which incurs double handling), and the other half is to Intracoastal Waterway, which would generate more benefits than the scenario that all waterborne tonnages are going to the intracoastal waterway.
[5] Half of the distance of 610.

USA vs. Abbott
Schedule A-2.1.1
Benefit Unit Rates

Description	Unit		Reference Unit Rate		Reference (Fiscal) Year/Quarter	Reference Fiscal Year Cost Index	2024/Q3 Cost Index		Costs
Transportation Cost Savings	Ton-mile	$	0.03	[1]	2007/Q4	680.42	1,171.29	$	0.04
Loading Cost	Ton	$	(1.28)	[2]	2014/Q4	792.07	1,171.29	$	(1.89)
Unloading Cost	Ton	$	(1.28)	[2]	2014/Q4	792.07	1,171.29	$	(1.89)

[1] The transportation cost savings for waterborne is $7 billion in 2007 (See Exhibit 3) The total inland water-borne freight miles was 271,617 million in 2007 (See Exhibit 18). $7B/271617=$0.03. Note that per a study performed by University of Arkansas (See Exhibit 2), barge transportation would not become cheaper than trucks until a travel distance of 459 miles; and would not surpass rail until 1,341 miles. Despite this, an average cost saving is assumed for any distance for barge transportation to be conservative.

[2] See Exhibit 1. The wharfage charge is $1.28 per ton for loading or unloading at Port of Corpus Christi.

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Schedule A-2.1.2
Benefit Quantity Estimates

Description	Unit	Reference Qty		Reference (Fiscal) Year/Quarter	Reference Fiscal Year Growth Index	2024/Q3 Growth Index		Qty
Laredo District Freight Tonnage	Ton	53,285,125.00	[1]	2016	1.00	1.23	[1]	65,431,198.47
Estimated Laredo District Waterborne Freight Tonnage	Ton		[2]					9,160,367.79
Rio Grande Valley Freight Tonnage	Ton	68,300,000.00	[3]	2018	1.00	1.20	[3]	82,221,134.72
Estimated Rio Grande Valley Waterborne Freight Tonnage	Ton		[2]					11,510,958.86

[1] See Exhibit 19. For Laredo District, the annual growth % is estimated as (112,300,355/53,285,125)^(1/29)-1=2.60%.
[2] Per Exhibit 5, 14% freight can be estimated as in-land waterborne. Since the reported freight demand for Rio Grande Valley has already included waterbore freight for the intracoastal waterway, 14% of total freight demand is a more than generous estimate of the increased waterbore transportation quantity.
[3] See Exhibit 17. For Rio Grande Valley, the annual growth % is estimated as (183.9/68.3)^(1/32)=3.14%.

Exhibit 19, Laredo District Profile - Texas Freight Mobility Plan 2018

Combined Freight Tonnage 2016–2045

County	2016 Tonnage	2045 Tonnage	% Change 2016-2045
Dimmit	929,149	852,115	-8%
Duval	301,667	653,276	117%
Kinney	72,098	93,592	30%
La Salle	3,035,887	3,669,656	21%
Maverick	12,380,768	23,395,644	89%
Val Verde	1,071,808	2,934,691	174%
Webb	34,997,662	79,662,768	128%
Zavala	496,086	1,038,613	109%
TOTAL	53,285,125	112,300,355	111%

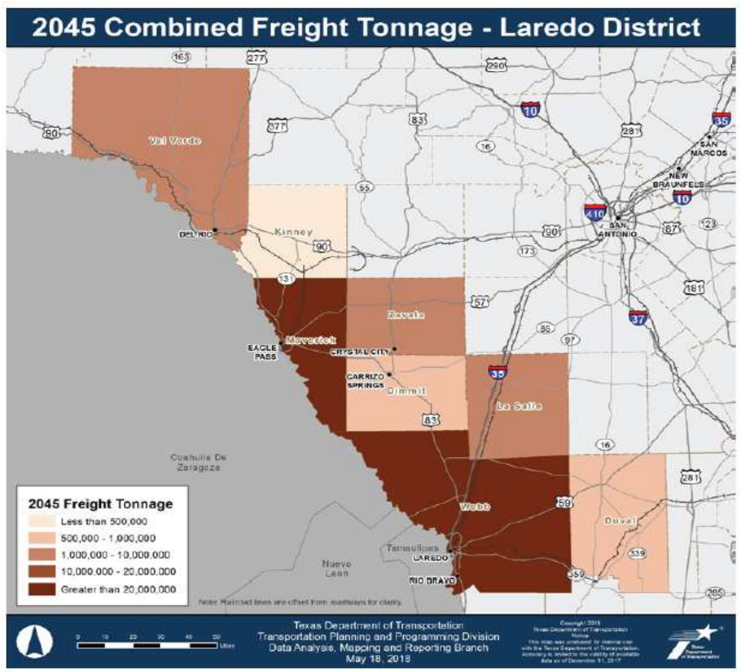

Exhibit 17 Rio Grande Valley Freight and Trade Transportation Plan

Exhibit 32. Freight Demand in the Rio Grande Valley, 2018 and 2050

Source: WSP and Cambridge Systematics analysis of Transearch, STB Carload Waybill Sample, and stakeholder input.

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Schedule A-3

Sensitivity Analysis	Without Improvement	With Improvement Alternative 1	With Improvement Alternative 2	
	present value	present value	present value	
Description	[1]	[2]	[3]	**Schedule Reference**
Base Scenario				
Incremental Costs	$0	$59,083,000,000	$95,020,000,000	Schedule A-1
Incremental Benefits	$0	$1,540,000,000	$10,185,000,000	Schedule A-2
Incremental Net Benefit	$0	($57,543,000,000)	($84,835,000,000)	
Benefit Cost Ratio	N/A	0.03	0.11	
Scenario - Cost Reduction to Break Even				
Incremental Costs	$0	$59,083,000,000	$95,020,000,000	
Required Cost Reduction to Change Recommendation		$57,543,000,000	$84,835,000,000	
Required Cost Reduction %	$0	97.4%	89.3%	
Scenario - Benefits Increase to Break Even				
Incremental Benefits	$0	$1,617,000,000	$10,694,250,000	
Required Benefits Increase	$0	$57,466,000,000	$84,325,750,000	
Required Benefits Increase %	N/A	3553.9%	788.5%	

[1] This alternative has no improvement.
[2] Alternative 1: A series of locks and dams spanning through the river stretch of RM 610 – 275.5, with pump stations for water recycling.
[3] Alternative 2: A series of locks and dams spanning through the river stretch from RM 610 to the Gulf Coast connecting to the intracoastal waterway, with pump stations for water recycling.